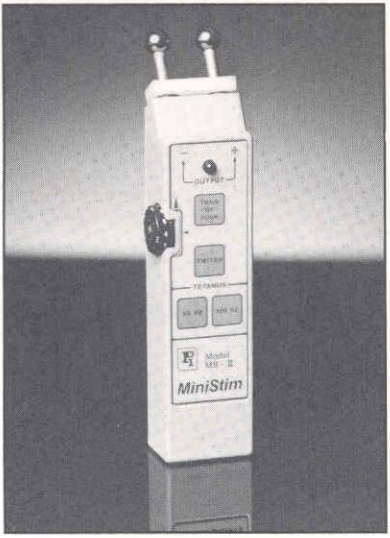
NOTE: Warranty Information MUST Be Returned



MiniStim™

Peripheral Nerve Stimulator, Model MS-II

INSTRUCTION MANUAL

Professional Instruments

a subsidiary of

Life-Tech,® Inc. · P.O. Box 36221 · Houston, TX 77236
(800) 231-9841 · In TX, (713) 495-9401

OPERATING MANUAL

MODEL MS-II

MiniStim™

Revised 2/89
ECO #2434
Part Number H-1147

TABLE OF CONTENTS

Section	Description	Page
1	**General Description and Specifications**	1
	1.1 Introduction	1
	1.2 Specifications	3
2	**Panel Markings and Controls**	5
3	**Operating Procedures**	
	3.1 General Precautions and Contraindications	7
	3.2 Use of Surface Electrodes for Transcutaneous Stimulation	9
	3.3 Use of the DP-M Bipolar Probe	15
	3.4 Use of Needle Electrodes for Subcutaneous Stimulation	15
4	**Clinical Use of Peripheral Nerve Stimulators**	
	4.1 The Neuromuscular Junction	19
	4.2 Depolarizing and Non-Depolarizing Blockade	19
	4.3 Detection of the Type of Neuromuscular Blockade—General	20
	4.4 Depolarizing Blockade	21

4.5 Sequence in Testing for Wedensky Inhibition ("fade" of tetanus) and Post-Tetanic Facilitation 23
4.6 Non-Depolarizing Blockade 24
4.7 Reversal of Non-Depolarizing Relaxants 27
4.8 Abnormal Response to Muscle Relaxants 28
4.9 The Train-of-Four 29

5 **Maintenance**

5.1 General 31
5.2 Battery Replacement 31

6 **Accessories and Spare Parts** 33

7 **Limited Warranty** 35

LIST OF ILLUSTRATIONS

Figure	Description	Page
2.1	MiniStim Front Panel Controls	5
3.1	Wrist Motor Points	10
3.2	Motor Points of the Facial Nerve	11
3.3	Output Connections to MiniStim	14
3.4	Connection of Monopolar Needles to MiniStim	17
4.1	Depolarizing Blockade Recovery Curve	22
4.2	Depolarizing Blockade Muscle Response Pattern	24
4.3	Non-Depolarizing Blockade Recovery Curve	25
4.4	Non-Depolarizing Blockade Muscle Response Pattern	26
5.1	Battery Replacement	32

SECTION 1

GENERAL DESCRIPTION AND SPECIFICATIONS

1.1 Introduction

The Model MS-II MiniStim is a battery powered Peripheral Nerve Stimulator for monitoring the effects of skeletal muscle relaxants.

MiniStim is a constant-voltage stimulator producing 0.22 millisecond square wave pulses with a maximum no-load output of 400 volts. Pulse delivery is indicated by the red flashing Output Stimulus Pulse Indicator. The Stimulus Amplitude Control Dial provides variable current control (0 to 50 milliamps into a 2K ohm load). The maximum output is more than adequate to ensure supramaximal subcutaneous stimulation of peripheral nerves in all patients and supramaximal transcutaneous stimulation in all but the most obese patients.

Three stimulus patterns can be generated: Train-of-Four, Twitch, and Tetanus. Four control keys select the pattern of stimulus pulse delivery.

Momentary depression of the Train-of-Four key generates one group of four stimulus pulses at the rate of 2 pulses per second. Continuous depression of the Twitch key generates stimulus pulses at the rate of 1 pulse per second so long as the key is depressed. Continuous depression of either the 50 Hz or 100 Hz keys generates tetanic stimulus rates of either 50 or 100 pulses per second as long as the key is depressed.

The tetanus pulse rates are selected to provide rapid demonstration of Wedensky inhibition (fade of tetanus) and post-tetanic facilitation—two criteria for determining the type and phase of neuromuscular block. The rates are high enough to ensure full tetanic response in stimulated muscle groups and the narrow pulse width eliminates direct muscle stimulation.

1.2 Specifications

1.2.1	Size (WXDXH):	1.3" x 1" x 5.25" (3.3cm x 2.5cm x 13.3cm)
1.2.2	Weight:	5 oz (142gm) including battery
1.2.3	Maximum Output Voltage	400V ± 10% (open circuit)
1.2.4	Output Current:	0 to 50 mA (2K ohms resistive load)
1.2.5	Pulse Width:	0.22 milliseconds
1.2.6	Pulse Risetime:	Less than 6 microseconds open circuit
1.2.7	Twitch Pulse Frequency:	One pulse per second
1.2.8	Tetanus Pulse Frequency:	Either 50 or 100 pulses per second

1.2.9	Train-of-Four Frequency:	Two pulses per second for two seconds
1.2.10	Battery:	Standard nine volt alkaline battery provides adequate power for several months of operation

CAUTION

Always set stimulus amplitude control dial to 0 before inserting or removing bipolar probe.

SECTION 2

PANEL MARKINGS AND CONTROLS

The Model MS-II MiniStim controls are illustrated in Figure 2.1.

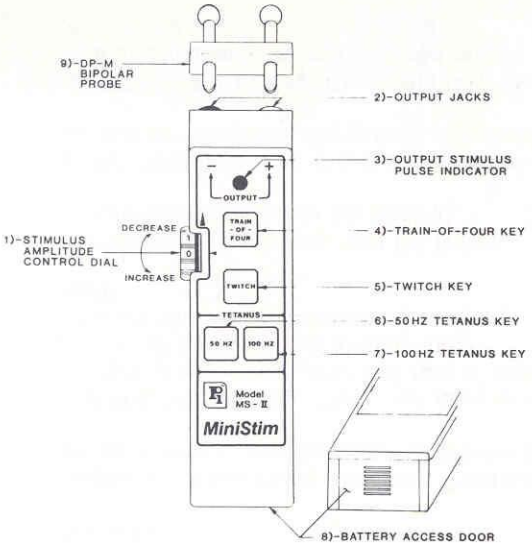


Figure 2.1
MiniStim Front Panel Controls

1) **Stimulus Amplitude Control Dial:** Rotation of the dial to higher numbers increases stimulus current.

2) **Output Jacks:** Two banana jacks accept DP-M bipolar probe (9). Red jack is (+) and black jack is (–).

3) **Output Stimulus Pulse Indicator:** Flashes red each time a stimulus pulse is delivered.

4) **TRAIN-OF-FOUR Key:** Press and release for a single group of four pulses at rate of two pulses per second. Wait at least three seconds after last pulse before pressing again.

5) **TWITCH Key:** Press and hold for Twitch stimulation at one pulse per second.

6) **50 HZ TETANUS Key:** Press and hold for Tetanus stimulation at fifty pulses per second.

7) **100 HZ TETANUS Key:** Press and hold for Tetanus stimulation at one hundred pulses per second.

8) **Battery Access Door:** Provides access to battery for replacement.

9) **DP-M Bipolar Probe:** Removable probe for transcutaneous stimulation.

SECTION 3
OPERATING PROCEDURES

3.1 General Precautions and Contraindications

3.1.1 **Explosive Atmospheres.** MiniStim is not intended for use in explosive atmospheres.

3.1.2 **Microshock Hazard.** In patients with pacemakers or cardiac abnormalities, the physician in charge of the patient must approve the use of the MiniStim.

3.1.3 **Neuromuscular Disease.** Patients with symptoms of myasthenia gravis, Bell's palsy, muscle weakness, or paralysis may not respond normally to nerve stimulation. The responses may be difficult or impossible to interpret relative to the state of muscle relaxation due to muscle relaxant drugs.

3.1.4 **Skin Disease.** The electrodes should not be applied to an area of the skin where injury, inflammation or other pathology is present or suspected.

3.1.5 **Tetanic Stimulation.** The Twitch and Train-of-Four stimulus is usually well tolerated in awake patients; however, tetanic stimulation can be uncomfortable for fully conscious patients. It is recommended that tetanus stimulation be performed only after anesthesia.

3.1.6 **Needle Insertion.** Insertion of a needle electrode for subcutaneous stimulation should be performed after adequate sedation. Needle electrodes should be placed in close proximity but not directly into the nerve.

MiniStim is not intended for nerve location for regional block. The Model NS-2CA DualStim is specifically designed for this purpose.

3.1.7 **Needle Burns.** When a needle electrode is used for subcutaneous stimulation, the small exposed conductive area of the needle can produce tissue burns if excessive stimulating current is used. Start with the Stimulus Amplitude Control Dial set to 0 and slowly increase current as required.

3.2 Use of Surface Electrodes for Transcutaneous Stimulation

3.2.1 **Cleaning the Skin.** Use OmniPrep (part number 11-0001) to clean the skin. After cleaning, wipe the skin dry.

3.2.2 **Location of the Electrodes.** The stimulating electrodes are usually placed on a motor point of the median or ulnar nerve at the wrist or on a motor point of the facial nerve. The negative electrode should be placed on the motor point, with the positive electrode nearby. Figure 3.1 shows the motor point locations at the wrist and Figure 3.2 shows the motor points of the facial nerve.

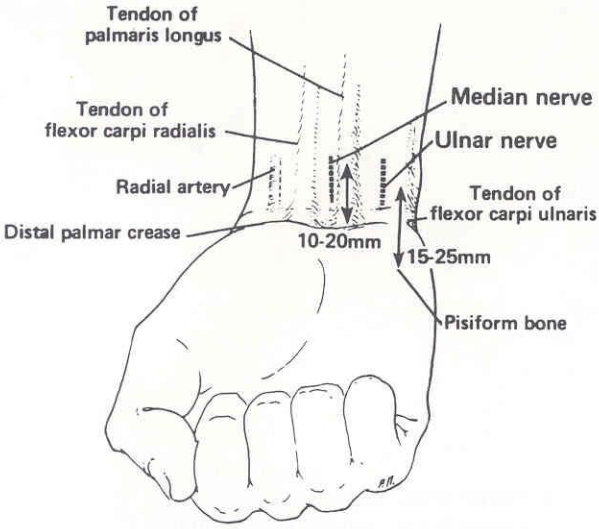


Figure 3.1
Wrist Motor Points

As shown, the median nerve motor point is located 10-20 mm proximal to the distal palmar crease between the tendons of the palmaris longus and the flexor carpi radialis; the ulnar nerve motor point is located 15-25 mm proximal to the pisiform bone on the thumb-side of the flexor carpi ulnaris tendon.

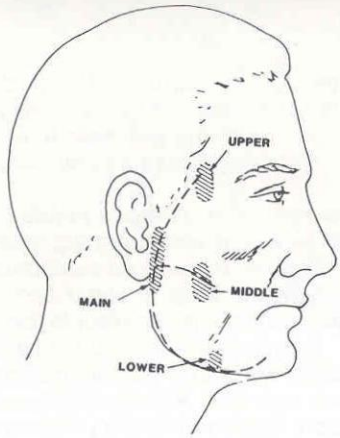


Figure 3.2
Motor points of the Facial Nerve

The motor point for the upper branch of the facial nerve is located in the area behind the eyebrow; the motor point for the middle branch is located just below and behind the cheekbone, and the motor point for the lower branch (not generally used in muscle relaxant drug monitoring) is located on the ridge of the lower jaw at the submental notch. The main submental motor point is located just anterior to the lower half of the pinna. Stimulation of the upper branch causes twitching of the eyebrow and eyelid, stimulation of the middle branch causes twitching of the muscles lateral to and above the

mouth, stimulation of the lower branch causes twitching of the chin, and stimulation of the main motor point causes twitching of the facial muscles supplied by all branches of the facial nerve, but usually preferentially in the vicinity of the eyebrow. If one of the branch motor points is used, care should be taken that the muscle twitch is located some distance away from the stimulating (negative) electrode to avoid the possibility of direct muscle stimulation.

Stimitrodes™ (part number SE-1) are recommended for surface electrodes. As packaged, Stimitrode electrode pairs (Figure 3.3) are spaced 0.75″ (1.9cm) apart as are the DP-1M bipolar probes. Stimitrodes incorporate a soft adhesive foam surrounding a small gel-free conductive area and are suitable for long term stimulation. The small conductive area provides precise, localized stimulation like the bipolar probe. If other electrode arrangements or wider separation is used, the Stimitrode pairs can be separated and placed as required.

3.2.3 **Attachment of Lead Wires to Stimitrodes and MiniStim.**
Stimitrodes have a male snap on the top. When using the EL-2M leads

(provided with MiniStim), slide the alligator clips onto the banana plugs at one end of the twisted paired wires as shown in Figure 3.3. Then open the alligator clip and place around the snap. Be sure to align the alligator clips so they do not touch each other thereby shorting out the stimulus.

When using the optional SL-24, SL-40, or SL-60 Snap-On Connector Extension Leads (Figure 3.3), simply press the female snap on the leadwire onto the male snap on the Stimitrode.

NOTE

The negative electrode is the active (stimulating) electrode. Therefore, the most effective stimulation is obtained when the black (negative) output jack of MiniStim is attached to the electrode placed distally along the nerve—i.e. at the location closest to the muscle.

The banana plugs on either the Model EL-2M, SL-24, SL-40, or SL-60 are inserted into the Output Jacks (Figure 2.1) on the top of MiniStim.

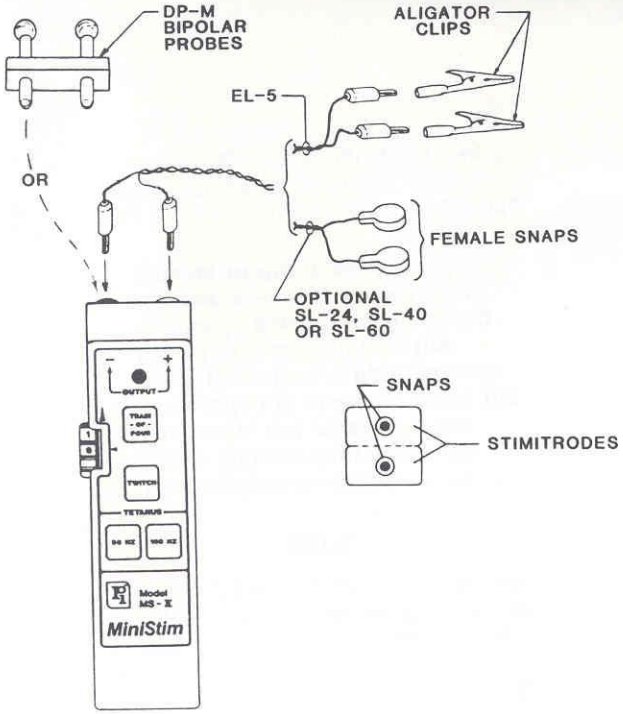


Figure 3.3
Output Connections to MiniStim

3.3 Use of the DP-M Bipolar Probe

The DP-M Bipolar Probe plugs into the MiniStim Output Jacks (Figure 2.1). The Bipolar Probe can be used to perform transcutaneous stimulation without attachment of a Stimitrode.

3.4 Use of Needle Electrodes for Subcutaneous Stimulation

MiniStim can be used for subcutaneous stimulation when necessary (e.g. excessively obese patient). When such a situation arises, teflon coated monopolar needles (e.g. Model 26U10, 26U20, 26U30, 26U40, or 26U50) are recommended.

CAUTION

Needle electrodes should be inserted in close proximity to, but not directly into the nerve.

CAUTION

Stimulus current required for subcutaneous stimulation is lower than with transcutaneous stimulation. Always set the Stimulus Amplitude Control Dial to 0 and increase the stimulus intensity slowly until satisfactory response to stimulation is obtained.

CAUTION

The small exposed surface area of needle electrodes may produce tissue burns if excessive stimulus current is used.

CAUTION

MiniStim is not intended for nerve location for regional blockade. The Model NS-2CA DualStim is specifically designed for nerve location for regional blockade.

Figure 3.4 illustrates the basic setup for needle stimulation. The Model EL-5 leads are inserted into the MiniStim Output Jacks, and the Model BPNA Banana Plug-to-Needle Adapters are attached to the banana plugs at the other end of the Model EL-5. The monopolar needles plug into the other end of the Model BPNA.

NOTE

The most effective stimulation will be obtained when the negative output terminal of the MiniStim is attached to the needle electrode placed distally along the nerve.

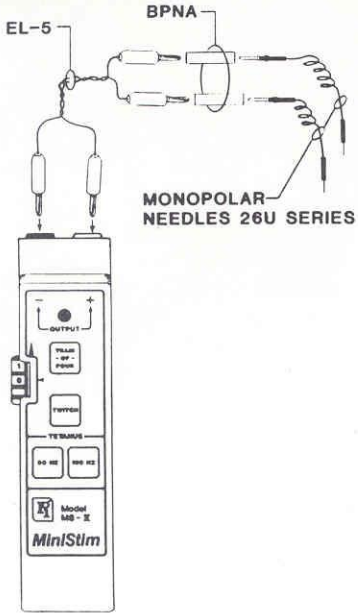


Figure 3.4
Connection of Monopolar Needles to MiniStim

SECTION 4

CLINICAL USE OF PERIPHERAL NERVE STIMULATORS

4.1 The Neuromuscular Junction

The impulse passing down a motor nerve is transmitted to a muscle across the motor end plate or neuromuscular junction. The transmission of this impulse is mediated via acetylcholine which becomes attached to specific receptor sites on the motor end plate. In general terms, it is blockade of transmission across the neuromuscular junction by muscle relaxants that produces muscle relaxation.

Although all muscle relaxants act on the neuromuscular junction, the mode and duration of action and intensity of blockade differ for different agents. These specific aspects of the action of neuromuscular agents can be differentiated by nerve stimulation.

4.2 Depolarizing and Non-Depolarizing Blockade

Physiological conduction across the neuromuscular junction is by depolarization of the motor end plate by acetylcholine. This depolarization is of exceedingly short duration.

Depolarization relaxants such as succinylcholine chloride cause depolarization of the end plate but the recovery period is much greater and extends to minutes rather than milliseconds. Prolonged depolarization causes neuromuscular blockade.

Non-depolarizing relaxants such as d-tubocurarine chloride do not cause depolarization; rather they occupy the specific receptor sites on the motor end plate. This prevents acetylcholine from attaching to the receptor sites. The duration of action of these drugs is probably dependent on how long they occupy the receptor sites.

The difference in the type of blockade produced by the depolarizing or non-depolarizing relaxants accounts for their differing response to nerve stimulation.

4.3 Detection of the Type of Neuromuscular Blockade—General

Depolarizing blockade is associated with a change in intensity of muscle response to nerve stimulation. Non-depolarizing blockade is accompanied by a change in the character, as well as the intensity of the muscle response to nerve stimulation. These different types of responses are described in more detail below.

4.4 Depolarizing Blockade

The drug most commonly used for short-term muscle relaxation is succinylcholine chloride which produces a depolarizing neuromuscular blockade. Figure 4.1 illustrates the normal progression of degree of relaxation following administration of succinylcholine chloride. A dose of 0.7 mg per kg generally produces complete abolition of the muscle response to nerve stimulation. After a varying interval (approximately 2 to 2.5 minutes) the neuromuscular junction starts to recover. There will then be a slight but consistent response to a Train-of-Four stimulus. A tetanic stimulus (50 per second) will produce a tetanic response of small but sustained intensity. Train-of-Four stimulus applied after the tetanic stimulus produces a muscle response equal in intensity and character to the original series of stimuli. In other words, there will be no Wedensky inhibition (fade of tetanus) and no post-tetanic facilitation.

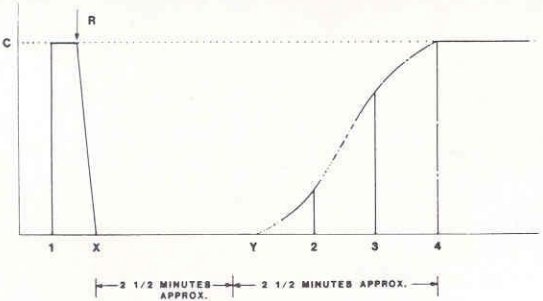


Figure 4.1
Depolarizing Blockade Recovery Curve

The height (C) represents a normal control response of muscle contraction to nerve stimulation. Succinylcholine chloride is administered at point R. During the interval of X-Y, there is no response to nerve stimulation. Stimulation during recovery at points 2 and 3 will then show increasing intensity of response to nerve stimulation. Stimulation at point 4 will produce a response of equal intensity to the control response at point 1, showing full recovery.

4.5 Sequence in Testing for Wedensky Inhibition ("fade of tetanus) and Post-Tetanic Facilitation

Normally a set sequence is used to test for Wedensky inhibition and post-tetanic facilitation. Figure 4.2 compares the response of a depolarizing blockade to a control response.

The nerve is stimulated in the following manner:

1) The nerve is stimulated with a Train-of-Four stimulus by pressing the Train-of-Four key momentarily.

2) The nerve is then subjected for 3 to 4 seconds to a tetanic series of stimuli at 50 per second by pressing and holding the 50 Hz Tetanus key.

3) After a pause of one to two seconds, the nerve is again stimulated as in Step 1.

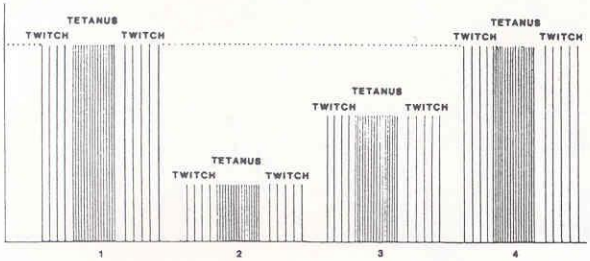


Figure 4.2
Depolarizing Blockade Muscle Response Pattern

The Train-of-Four/Tetanus/Train-of-Four stimulus pattern is repeated at intervals 1, 2, 3 and 4. The intensity of responses is represented by the height of the lines in the diagram. In depolarizing blocks, the intensity, not the character of the response, is changed.

4.6 Non-Depolarizing Blockade

There is a large degree of variation in response to non-depolarizing relaxants dependent on many factors in addition to the initial dose. These relaxants are often administered on an average-dose basis, but the exact response to any dose in a particular patient can be assessed by use of MiniStim. Furthermore, the duration of action may be observed visually without dependence on clinical impressions.

Figure 4.3 illustrates the normal progression of blockade following administration of d-tubocurarine chloride.

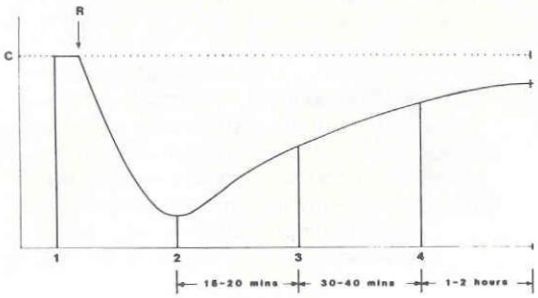


Figure 4.3
Non-Depolarizing Blockade Recovery Curve

D-tubocurarine chloride is administered at point R. The sequence described for demonstrating Wedensky inhibition and post-tetanic facilitation (Section 4.5) is carried out at 1, 2, 3, and 4.

The response patterns are illustrated diagrammatically in Figure 4.4.

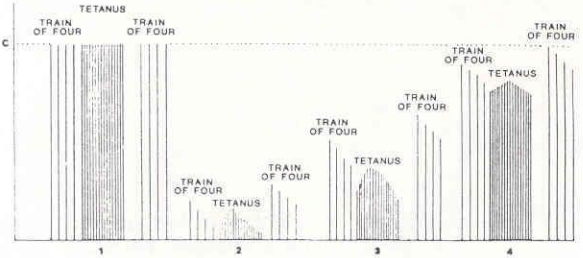


Figure 4.4
Non-Depolarizing Blockade Muscle Response Pattern

The Train-of-Four/Tetanus/Train-of-Four stimulus pattern is repeated at intervals 1, 2, 3, and 4.

The following important features are illustrated:

1) At interval 2, the initial response to a single Train-of-Four stimulus rapidly diminishes and may disappear completely. The tetanus response is poorly sustained (Wedensky inhibition), but the response to a single Train-of-Four stimulus after the tetanus stimulation is increased (post-tetanic facilitation).

2) At interval 3, Wedensky inhibition is harder to detect visually but post-tetanic facilitation is clearly visible.

3) At interval 4, Wedensky inhibition is almost impossible to detect visually, but, nevertheless, post-tetanic facilitation can be positively identfied.

The fade-off in intensity of response to the initial series of one second twitch stimuli is harder to detect when the degree of neuromuscular blockade is slight.

4.7 Reversal of Non-Depolarizing Relaxants

Normally, at the end of surgery, the residual effects of non-depolarizing relaxants are reversed with atropine and endrophonium chloride (or neostigmine). The dosage is often empirical, based upon experience and related to the response of the patient. The MiniStimII Peripheral Nerve Stimulator provides a means of objectively monitoring the dosage of the reversing agent. For example, endrophonium chloride (or neostigmine) can be administered in incremental doses until there is no sign of Wedensky inhibition or post-tetanic facilitation - thus objectively confirming absence of residual curarization which could cause post-operative respiratory depression.

Usually, it is not possible to reverse the effects of non-depolarizing relaxants while marked fade of tetanic response to nerve stimulation occurs, or when no muscle response at all can be demonstrated to a tetanic stimulation.

4.8 Abnormal Response to Muscle Relaxants

The importance of abnormal or reduced pseudo-cholinesterase levels is well known to the anesthetist. The very prolonged relaxation produced by succinylcholine chloride in patients with this abnormality is well documented. MiniStim will quickly detect any such prolongation and permit minute-to-minute assessment of the patient's state of relaxation.

When using succinylcholine chloride intermittently or combined with a potentiating agent, the development of a non-depolarizing element to the neuromuscular blockade will be detected rapidly when monitoring continuously with the MiniStim. An example of such a situation is occurrence of post-tetanic facilitation during the recovery phase after administration of succinylcholine chloride.

In certain types of surgery, sudden unwanted movement can be dangerous. Continuous monitoring of neuromuscular transmission enables incremental doses of relaxant to be administered in time to prevent this from occurring. This is of particular value when using intermittent succinylcholine chloride techniques.

4.9 The Train-of-Four

The response to a brief train of stimuli is a more sensitive index of receptor blockade by a competitive neuromuscular blocking agent than is the response to a single twitch. Also, the Train-of-Four stimulus may produce less discomfort is a conscious patient than a tetanic stimulus.

Briefly pressing the Train-of-Four key on MiniStim produces four pulses at a frequency of two pulses per second.

Each train can be repeated as often as every ten seconds. Four pulses are chosen because it has been found that during partial curarization, the fourth response is usually maximally depressed. The ratio of the amplitude of the fourth response to the amplitude of the first response in the train is a widely used measurement of the degree of neuromuscular blockade.

SECTION 5
MAINTENANCE

5.1 General

Other than replacing the battery periodically, MiniStim requires no user maintenance.

5.2 Battery Replacement

Replace the 9 volt alkaline battery at least every six months or sooner with frequent use. Use only a good quality 9 volt alkaline battery (e.g. Duracell).

To replace the battery follow these steps:

1) Slide off the Battery Access Door (Figure 5.1).

2) Tilt the MiniStim to slide out the old battery.

3) Insert the new battery into MiniStim as shown in Figure 5.1. (Note: if the battery is inserted backwards, it will stick out slightly and the Battery Access Door cannot be replaced).

4) While holding the back of the battery in place with your thumb, slide the Battery Access Door back into place.

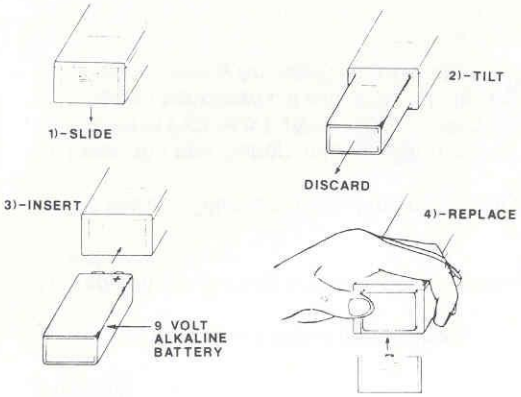


Figure 5.1
Battery Replacement

SECTION 6

ACCESSORIES AND SPARE PARTS

Description	Part Number
OmniPrep Skin Cleaner	11-0001
Electrode Gel	EP-2
Disposable Surface Stimulating Electrodes	SE-1
Extension Leads	EL-2M
Bipolar Probe	DP-M
MiniStim II Carrying Case	CC-MII
Battery (9 volt alkaline)	H-452

SECTION 7

LIMITED WARRANTY

Life-Tech products have a warranty against defects in materials and/or workmanship for a period of one year after delivery to the original purchaser, except for the special cases listed below. Replacement of a defective product with a new product to fulfill the terms of this warranty will not extend the warranty period.

If the product must be returned to Life-Tech, first obtain a Return Authorization Number from the Service Department. You are responsible for prepaying shipping costs one-way to Life-Tech. While your product is being repaired, Life-Tech, to the best of its ability, will provide telephone assistance.

Special Cases:

1) The warranty for electrodes is for 90 days from delivery.

2) Supplies and disposable items are expressly excluded from this warranty.

3) Loaners for instruments are not provided under this warranty.

4) Products resold by Life-Tech but produced by another manufacturer carry the warranty of the original manufacturer.

Damage due to accident, abuse, fire, lightning, negligence, water, excessive pressure or misuse are not covered by this warranty. This warranty shall not apply if the product has been repaired or altered by anyone other than an authorized representative of Life-Tech unless under direct instructions of Life-Tech authorized personnel.

This warranty may not be modified in any respect except in writing and signed by authorized individuals. This warranty is in lieu of all other warranties, expressed or implied.

Life-Tech, Inc., P.O. Box 36221
Houston, Texas 77236-6221

Telephone: 1-800-231-9841
(In Texas) 713-495-9401

Telex: 791364 LIFE TECH HOU

Date of Delivery: **month,** **year**